[COMMITTEE PRINT]

REVIEW OF THE NATIONAL AERONAUTICS AND SPACE ACT OF 1958, AS AMENDED

REPORT

together with

ADDITIONAL VIEWS

PREPARED BY THE

SUBCOMMITTEE ON
SPACE SCIENCE AND APPLICATIONS

TRANSMITTED TO THE

COMMITTEE ON SCIENCE AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

NINETY-EIGHTH CONGRESS

SECOND SESSION

Serial EE

SEPTEMBER 1984

Printed for the use of the Committee on Science and Technology

---

U.S. GOVERNMENT PRINTING OFFICE
38-705 O WASHINGTON : 1984

H702-15

COMMITTEE ON SCIENCE AND TECHNOLOGY

DON FUQUA, Florida, *Chairman*

ROBERT A. ROE, New Jersey
GEORGE E. BROWN, JR., California
JAMES H. SCHEUER, New York
RICHARD L. OTTINGER, New York
TOM HARKIN, Iowa
MARILYN LLOYD, Tennessee
DOUG WALGREN, Pennsylvania
DAN GLICKMAN, Kansas
ALBERT GORE, JR., Tennessee
ROBERT A. YOUNG, Missouri
HAROLD L. VOLKMER, Missouri
BILL NELSON, Florida
STAN LUNDINE, New York
RALPH M. HALL, Texas
DAVE McCURDY, Oklahoma
MERVYN M. DYMALLY, California
PAUL SIMON, Illinois
NORMAN Y. MINETA, California
RICHARD J. DURBIN, Illinois
MICHAEL A. ANDREWS, Texas
BUDDY MacKAY, Florida
TIM VALENTINE, North Carolina
HARRY M. REID, Nevada
ROBERT G. TORRICELLI, New Jersey
FREDERICK C. BOUCHER, Virginia

LARRY WINN, JR., Kansas
MANUEL LUJAN, JR., New Mexico
ROBERT S. WALKER, Pennsylvania
WILLIAM CARNEY, New York
F. JAMES SENSENBRENNER, JR., Wisconsin
JUDD GREGG, New Hampshire
RAYMOND J. McGRATH, New York
JOE SKEEN, New Mexico
CLAUDINE SCHNEIDER, Rhode Island
BILL LOWERY, California
ROD CHANDLER, Washington
HERBERT H. BATEMAN, Virginia
SHERWOOD L. BOEHLERT, New York
ALFRED A. (AL) McCANDLESS, California
TOM LEWIS, Florida

HAROLD P. HANSON, *Executive Director*
ROBERT C. KETCHAM, *General Counsel*
REGINA A. DAVIS, *Chief Clerk*
DAVID S. JEFFERY, *Minority Staff Director*

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

HAROLD L. VOLKMER, Missouri, *Chairman*

BILL NELSON, Florida
MICHAEL A. ANDREWS, Texas
GEORGE E. BROWN, JR., California
RALPH M. HALL, Texas
MERVYN M. DYMALLY, California
NORMAN Y. MINETA, California
BUDDY MacKAY, Florida
ROBERT G. TORRICELLI, New Jersey

MANUEL LUJAN, JR., New Mexico
BILL LOWERY, California
ROD CHANDLER, Washington
HERBERT H. BATEMAN, Virginia
ROBERT S. WALKER, Pennsylvania

LETTER OF SUBMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC, July 16, 1984.

Hon. DON FUQUA,
Chairman, Committee on Science and Technology,
House of Representatives, Washington, DC.

DEAR MR. CHAIRMAN: I am forwarding herewith this report in review of the National Aeronautics and Space Act of 1958, as amended, based on hearings held by the Subcommittee on Space Science and Applications in October 1983.

The consensus view at these hearings was that the National Aeronautics and Space Act of 1958 is a remarkably sound piece of legislation that has reliably served the Nation as a basis for U.S. policymaking on space matters for twenty-five years. At the same time, the Act continues to retain a vision for future U.S. activity in space.

Through these hearings, the Subcommittee could focus on the adequacy of NASA's charter and mission for future civilian space activities. Several enhancements to the Space Act were discussed at the hearings and shortly thereafter took root in legislative form.

As part of this year's NASA authorization (H.R. 5154), the Committee recommended, and the Congress adopted, two changes to the National Aeronautics and Space Act. The new language is intended to acknowledge, and enhance, NASA's work in the commercialization area and in the earth sciences.

Another aspect of the hearings, and one of great interest to the Subcommittee, concerned the need for long-range planning for civilian space activity. I am encouraged that the NASA Authorization Act also provides for the establishment of a National Commission on Space, which will assist in the articulation of long-range goals for civilian space activity.

These changes reflect the vastness and opportunities of space, and expand our foundation for addressing the future.

I commend this report to you and the other Members of the Committee.

Sincerely,

HAROLD L. VOLKMER, *Chairman,*
Subcommittee on Space Science
and Applications.

CONTENTS

	Page
Letter of submittal	III
Conclusions and recommendations	1
Chapter I—Introduction	4
Chapter II—Summary of witness testimony	8
Chapter IiI—Summary of major issues	24
Appendix A—List of witnesses	52
Appendix B—Brief sectional analysis of the National Aeronautics and Space Act of 1958	53
Additional views submitted by Representative Robert S. Walker	54

CONCLUSIONS AND RECOMMENDATIONS

Based on analysis of the witness testimony, the following conclusions and recommendations emerge:

1. The National Aeronautics and Space Act of 1958 has reliably served as a basis for U.S. space policy determinations for twenty-five years. The Act today remains a definitive, visionary guide for U.S. civilian space policy.

2. The value of long-range planning to improved space policy decisionmaking is recognized. Moreover, the growing breadth and complexity of issues concerning U.S. space policy warrant that a more comprehensive, long-range planning process be undertaken by NASA, as the lead civilian space agency. The steps should begin now toward the development of a long-range plan for the U.S. civilian space program, identifying national goals for U.S. civilian space activity during the next 20 years. NASA should formulate such a plan in consultation with other agencies involved in civilian space activities, and prepare such a plan for submission to the Congress.

3. Increasingly complex technological and policy issues concerning U.S. space activity demand timely, informed and thorough public debate and evaluation. The presence of an independent, broadly representative and well coordinated space policy advisory apparatus assures more knowledgeable and confident decision-making on U.S. space policy issues. It concomitantly reinforces NASA's presence within the Executive Branch on matters involving civilian space policy issues.

4. A stronger voice within the Executive Branch for the civilian portion of our space program is desirable. Civilian space policy should be accorded equal priority to national security considerations in senior interagency coordinating efforts.

5. NASA's most important contributions in providing space transportation systems are the achievement of assured, reliable access to space at low cost. NASA should continue to seek ways to achieve these goals, including the separation, within NASA, of Shuttle operations management activity from R&D activities. Any such arrangement should seek optimum efficiency in STS operations while preserving the integrity of space science and applications activity and allowing a healthy symbiosis among the respective missions.

6. There are sound technological, economic, strategic and cost reasons to proceed now with production of a fifth orbiter. Further postponement of production startup appears unwise.

7. Commercialization of space will occur in an evolutionary way. NASA's ability to facilitate commercialization of space is as much a function of time and learning as it is the taking of specific governmental steps to encourage the process. NASA's commercial orientation should be enhanced, and the agency can do so through the following steps:

   a. NASA should assume a lead role in research and development and expand support for all non-regulatory matters related to commercial space endeavors. NASA should work with industry to plan and carry out an R&D program that will maximize opportunities for commercial development of space.

   b. A permanent organization is needed within NASA to support a space commercialization function. NASA should establish a commercialization office with the resources, authority and direction necessary to ensure effective facilitation of space commercialization activities. Such an organization should give special attention to expanding industrial activities in space by providing space technological information to non-aerospace firms.[1]

   c. Existing contractual mechanisms such as the Joint Endeavor Agreement (JEA), Technical Exchange Agreement (TEA), and Industrial Guest Investigator (IGI), are effective instruments for encouraging the private sector to join with NASA in pursuing space activities.[2] Greater employment of these mechanisms and simplification and expediting of their contractual processes should be sought in order to promote cooperation.

   d. NASA should not necessarily discontinue R&D efforts in any area in which industry has assumed a dominant operational role. NASA should maintain a continuing R&D role whenever it is in the national interest.[3]

---

[1]See Recommendation #4, Space Commercialization, Report of the Subcommittee on Space Science and Applications, 98th Congress, 1st Session, Serial R, October 1983.

[2]See conclusion #5, Ibid.

[3]See conclusion #6, Ibid.

8. NASA has not established an explicit role in space applications. NASA's space applications program would benefit from the definition and articulation of the agency's role and objectives in space applications, emphasizing identification of civilian applications and user involvement and needs.

9. The separation of the civilian and military space programs is essential and should be maintained. Buildup of space weapons research or other military programs should not be accomplished at the expense of civilian space activities. Congressional and Executive oversight and monitoring of this and other aspects of the civilian-military relationship should be thorough and continuous.

10. A healthy space science program is essential to maintain continued strength and vitality of the space program and to derive therefrom social, scientific and economic benefits. NASA should initiate enhancements in the space and earth sciences, including pursuit of planetary exploration through a renewed commitment to exploration of the solar system, and expansion of human knowledge of the Earth and phenomena in the atmosphere and space. NASA should also coordinate space science activities with the National Science Foundation.

11. International cooperation can enhance the capability and accelerate development of our space programs. Our space policies have not fully realized the opportunities and returns, including scientific, political and economic, to be gained by enhanced international cooperative activity. International cooperative space activity need not compromise the Nation's ability to maintain preeminence in space science and technology. Moreover, the growing importance of international space policy considerations, particularly in view of increasing commercial space activity, warrants that NASA develop an acute awareness of the international implications of space policy decisions.

12. The degree to which many of our expectations of future space operations and capability are realized will depend on, and often already assume, the presence of a permanent space station in low earth orbit. Administration and Congressional commitment to a permanent space station is vital to the continued leadership, growth and vision of the U.S. space program.

38-705 O - 84 - 2

I. INTRODUCTION

Our space policy is embodied in the enabling legislation of the United States space program, the National Aeronautics and Space Act of 1958.[4] Basic tenets of this policy are:

> "Activities in space should be devoted to peaceful purposes for the benefit of all mankind."
>
> "The general welfare and security of the United States require that adequate provision be made for aeronautical and space activities"; and
>
> "Such activities shall be the responsibility of, and shall be directed by, a civilian agency exercising control over aeronautical and space activities sponsored by the United States, except that activities peculiar to or primarily associated with the development of weapon systems, military operations, or the defense of the United States shall be the responsibility of and shall be directed by, the Department of Defense."

The national objectives set forth in Title I of the Space Act include:

(1) The expansion of human knowledge of phenomena in the atmosphere and space;

(2) The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;

(3) The development and operation of vehicles capable of carrying instruments, equipment, supplies, and living organisms through space;

(4) The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;

(5) The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the applications thereof to the conduct of peaceful activities within and outside the atmosphere;

---

[4]Public Law 85-568, as amended.

(6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by such agencies, to the civilian agency established to direct and control non-military aeronautical and space activities, of information as to discoveries which have value or significance to that agency;

(7) Cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof; and

(8) The most effective utilization of the scientific and engineering resources of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment.

Although there have been amendments and extensions to this legislation, the objectives expressed in the Act remain essentially intact to this day. This, in itself, is good, but in light of the striking advances made in space science and particularly in space applications, it appears timely to reexamine the role of government, and particularly that of NASA, in space activities. These hearings were also a follow-on, and complementary, to previous reviews undertaken annually by the Subcommittee emphasizing national space policies and goals. In September 1981, the Subcommittee held hearings on future space programs, which were designed to look at the space program from the point of view of society.[5] Other hearings were held to review the major tenets of the previous Administration's space policy.[6]

Moreover, recent concern has surfaced that NASA might be entering its second quarter century with less vision than launched the agency into its first twenty-five years. Our civilian space program over the last twenty-five years has produced national successes and demonstrated a technological prowess which suggests that our future feats in space are limited not by our imaginations but by our ability to mobilize our national resources and capabilities. Whether NASA, as the lead civilian space agency, is positioned to meet the challenges of our space future is a critical and timely question for Congressional attention. The occasion of

---

[5]Hearings, Future Space Programs, September 21, 22, 23, 1981, 97th Congress, Serial 50; Report of the Subcommittee on Space Science and Applications, Future Space Programs: 1981, 97th Congress, Serial Z.

[6]Hearings, United States Civilian Space Policy, July 23-24, 1980, Serial 153; Report of the Subcommittee on Space Science and Applications on United States Civilian Space Policy, 97th Congress, Serial C.

NASA's twenty-fifth anniversary seems particularly suitable for pausing to examine how the major changes in the space program and our sense of where the Nation is headed in space will affect NASA's future role and mission.

The character of the civilian space program has been changing significantly as a number of major trends become apparent. These include:

-- Although NASA is still the largest single civilian agency in space activities, other players have become more visible in the arena, including other U.S. government agencies, private-sector organizations, and foreign entities. How does NASA fit into this infrastructure?

-- The Space Shuttle is making the transition from development to full scale operations. A clearly defined role for NASA beyond the R&D phase remains as yet undetermined, both for the Shuttle and for other space transportation systems. Is it time that we define NASA's role?

-- To date, the space program could be characterized as a series of individual programs of finite durations, as ends in themselves. Our future in space will rely more on the establishment and maintenance of space facilities, that is, programs that will be means rather than ends. What does this mean for NASA?

-- Space commercialization has become an important force in space activities. The trend can be expected to accelerate, and will bring with it the need for new business and legal understandings and arrangements. What should be the respective roles of government and of the private sector in accomplishing the goals of the Nation's space program?

-- The past few years have seen a growing emphasis on the military uses of space. While the civilian and military functions have remained separate, the increased emphasis on national security concerns appears to be causing some blurring of the two missions. Should these be further clarified in NASA's organic act?

-- The international dimension in space activity is gaining increased significance. As other nations expand their capabilities in space, our perspective as a world player in an international arena will change, requiring an enhanced understanding and appreciation of international cooperation and competition. What kinds of changes should NASA make to reflect this perspective?

Due to the significance of these trends and their influence on the shape of U.S. space policy, the Subcommittee initiated a review of the 1958 space policy act. To begin its review, the Subcommittee initiated a series of hearings focusing on NASA's future mission and responsibilities as defined in Title I of the Space Policy Act (Title I is reprinted herein on page 1). The Subcommittee's purpose is to attempt to determine if the policies and purposes contained in the 1958 act adequately reflect the direction and scope of NASA's future, including whether NASA's ability to keep pace with changes in the space program is in any way limited by its current charter. The Subcommittee's primary objective is to shape a space infrastructure to utilize the most productive blend of government and private resources for the Nation's future investment in space. The starting point for such a task is to define a role for NASA, both as the lead civilian space research and development agency and as a partner with other agencies, private industry, academia, and foreign nations. Major issues the Subcommittee attempted to address during these hearings included:

- NASA's role in the development and operation of future space transportation systems;
- NASA's role in space science;
- NASA's role in space applications;
- NASA's role in national security;
- NASA's role in commercialization and technology transfer;
- NASA's role in an era of enhanced international cooperation and competition;
- NASA's role in space policy formulation.

The Subcommittee has drawn upon the expertise of administration officials, former NASA administrators, industry experts, and space scientists, among others, who have not only witnessed and participated in NASA's evolution to the present day, but who also share a vision for its future.

II. SUMMARY OF WITNESS TESTIMONY

During the Subcommittee's four days of hearings, the Subcommittee received testimony from the following persons:

October 18, 1983

Hon. George E. Brown, Jr.
Member of Congress (D-CA)

Hon. Robert S. Walker
Member of Congress (D-PA)

Daniel J. Fink, Chairman
NASA Advisory Council

John Gibbons, Director
Office of Technology Assessment

October 19, 1983

Tom Donahue, Chairman
Space Science Board
National Academy of Science

Willis H. Shapley
Space Applications Board
National Academy of Sciences

John E. Naugle, Senior Director
Lease Craft Programs
Fairchild Space Company
(Former Chief Scientist, NASA)

October 25, 1983

John Yardley, President
McDonnell-Douglas Astronautics Co.

Dr. Christopher C. Kraft, Jr.
Former Director
NASA/Johnson Space Center

Jerome Simonoff, Vice President
Citicorp Industrial Credit, Inc.

Karl G. Harr, Jr., President
Aerospace Industries Association

October 26, 1983

Hon. James M. Beggs, Administrator
National Aeronautics and Space Administration

Panel of Former NASA Administrators:

Dr. James C. Fletcher (1970-1977)
Dr. Thomas O. Paine (1968-1970)
Dr. Robert A. Frosch (1977-1981)

Summaries of chese individuals' testimony follow:

Robert S. Walker, Member of Congress (R-PA)

Congressman Robert S. Walker, a Member of the Subcommittee on Space Science and Applications, testified that the manner in which our space efforts are structured over the next few decades may well make the difference between little, or no, economic growth on the one hand, and rapid expansion due to commercialization in space which could lead to a new trillion dollar economy, meaning in 1983 terms 35 million new jobs by the turn of the century. He proposed an amendment to the Space Act that would include as part of our national policy to "seek to the maximum extent possible the fullest commercialization of those programs which have been proven by research and development". Mr. Walker believes the less government role the better.

George E. Brown, Jr., Member of Congress (D-CA)

Congressman Brown, a Member of the Subcommittee on Space Science and Applications, testified on the need to recommit to the policy principles contained in the NASA organic act by taking a long range view of science and space. Noting today's complexity of space policy issues, Rep. Brown recommended joint Congressional reviews of space programs and policy formulation be undertaken.

Congressman Brown also recommended a new civilian Senior Interagency Group (SIG) on Space be formed as a counterpart to the current SIG on space chaired by the President's National Security Advisor. This step, or the co-chairing by the NASA Administrator of the current SIG on Space, would balance the heavy military emphasis that has developed within civilian space programs.

In the space science area, Rep. Brown recommended the expansion of a long-range solar system exploration program consistent with the recent recommendation of the Solar System Exploration Committee (SSEC). The SSEC study, he noted, could serve as a model for planning in other areas of space activity.

Brown noted that NASA could use additional, and independent, advice on U.S. space activities, and recommended the establishment of a Space Advisory Board, modeled after the EPA's Science Advisory Board, or the DOE's Energy Research Advisory Board, that would be responsive to both NASA and Congress.

Rep. Brown recommended promoting the application and commercial use of space technologies developed by NASA through support of aggressive applications, technology utilization, and technology transfer programs. This approach, Brown noted, would be preferable to the Administration's proposal to commercialize the Landsat system. NASA should be allowed and encouraged to conduct operational programs and applied research, as well as basic R&D, if Landsat and other technologies are to be developed through the space program to the commercial stage.

Institutional changes at NASA could help promote commercial use of space technologies, such as combining the Technology Utilization Office, space applications activities and commercialization activities into a separate Office of Space Applications and Commercialization. Such a change could improve our ability to define and carry out the process of commercialization.

Rep. Brown voiced concern about the eroding distinction between military and civilian activities in space which, he said, is contributing to the reversal of the tradition of openness that characterized the first twenty five years of the U.S. space program. This trend warrants the Committee's greater attention to a major emerging policy debate concerning military and civilian interaction and conflict in space.

Finally, Rep. Brown noted the importance of international space cooperation on political, scientific, and economic levels, and concern over the vulnerability of international programs to budget cutbacks.

Daniel J. Fink, Chairman, NASA Advisory Council

Mr. Fink presented the findings and recommendations of the "Mission of NASA" Study undertaken by a NASA Advisory Council task force.

Mr. Fink described the 1958 Space Act as a remarkable piece of legislation that has stood the test of time marked by phenomenal change. The Act remains today a strong guide to national purpose and policy in aeronautics and space as the basis for the missions of NASA.

A major recommendation of the "Mission of NASA" study concerns the establishment of a new NASA organization (within the agency) to manage Shuttle operations and utilization, with a "fencing off", or confinement of manpower, finances, and facilities to serve only those objectives. The Shuttle operations organization would be responsible for marketing and sustaining engineering support but not for future development activities. The Council concluded that the STS is not ready for commercialization, but is continuously studying commercialization considerations.

The Council also recommended that NASA's future policy reflect an incremental or institutional cost basis for launch and service pricing for STS users, in lieu of a full recovery of recurring costs.

In the space sciences, concern over an unclear delineation of responsibility between NASA and NSF in ground-based observations and theoretical and laboratory work associated with space missions prompted the task force to recommend NASA assume a leadership role in coordinating such space science programs.

The task force also found that NASA's unique charter and skills prime the agency for exploration of the solar system with the eventual goal of utilizing the resources and knowledge of space for human benefit. In addition, planetary exploration should be advanced to promote understanding of processes involved in global surface and atmospheric changes important to living systems. The task force recommendations would enhance those of the Solar System Exploration Committee.

The task force recommended that NASA assume a more clearly defined role in the space applications area, to identify civilian applications of space operations involving the appropriate users and providers of services in identifying program requirements and priorities; that NASA conduct research and technology development that can't be conducted or funded by other agencies; and provide utility demonstration and experimental operation of such space systems.

Although the task force did not address the NASA-DOD relationship, it did recommend that in the space technology area, NASA's role should, as it is in aeronautics, be supportive of total national requirements, not just agency needs.

The task force emphasized the importance of international cooperative activity in space to U.S. technological leadership and prestige. Our commitments to cooperative ventures with other nations could be strengthened, as well as our awareness and utility of aerospace programs as foreign policy instruments. The task force also questioned whether U.S. policy on technology transfer is not counterproductive in limiting the ability of foreign nations to procure American space products rather than having to develop such products domestically.

The mission of NASA study concluded with the following statement of mission:

> ". . . . NASA has a dual mission -- in space and the atmosphere -- portions of which are overlapping.
>
> NASA's space mission is to conduct activities on behalf of the people of the United States in collaboration with other nations, to:

- explore the solar system and study its planetary processes, including, as appropriate, those governing the Earth, for the benefit of humankind;
- pursue a program of fundamental scientific research in space to expand human knowledge;
- plan and implement space technology programs and research into the use of the environment of space in order to provide for the continued advance of the national space capability and its exploitation for public and commercial purposes;

- and, to achieve these ends, create the capability for an expanded human presence in space and develop and assure the operation of launch and space vehicles."

John Gibbons, Director, Office of Technology Assessment

Dr. Gibbons testified that NASA is experiencing a gap problem between NASA's traditional activities, which have concentrated on research and the development of vehicles and on space exploration, and the challenge of applying the knowledge that is learned and providing services to users. He pointed to Landsat as an example of the inadequacy of present arrangements. The situation will require linking the research and industrialization processes, involving close cooperation among NASA, the academic community and the aerospace industry.

Dr. Gibbons also discussed the changing relative magnitudes of the civilian and military space programs, noting two potential consequences of that trend. First, NASA may find itself competing with the Defense Department and the aerospace industry for manpower, and the U.S. commitment to the development and peaceful use of outer space may be perceived internationally as less strong.

Dr. Gibbons voiced concern about budgetary stresses and limitations on national resources, if the government commits to a space station. Unless substantial new funding commitments are made, a new undertaking will be done at the expense of other programs. Substantial start-up time will also be required because national resources are limited. Gibbons compared the space station initiative to the Apollo program, describing the space station as a goal without termination. A permanent manned space facility will require substantial rationale in terms of identified national need and opportunity. Since it currently has little or no support from defense and space science communities, NASA may want to consider it as a joint venture with industry.

Dr. Gibbons lamented the continued absence of a Congressionally established and broadly representative professional body charged with providing guidance on national space policy. Consequently, decisions concerning space policy are being made with insufficient regard to the Nation's long-term interests and postures in space.

Consequently, Dr. Gibbons suggested several options be explored, including the reestablishment of the National Aeronautics and Space Council, or a Presidential Commission to include Congressional representation.

Dr. Gibbons concluded by characterizing the 1958 NAS Act as permissive, but warned that NASA's initiatives, which are primarily of interest to the scientific, engineering, aerospace and military communities, are no longer appropriate in today's context of growing international competition and increased private sector interest in space. There is a need, he said, to revisit the goals and directions of U.S. pursuits in space.

Thomas M. Donahue, Chairman, Space Science Board

Dr. Donahue testified that in the interest of space science, there is no need to change the current NASA charter, nor is there need to develop new technological systems. Dr. Donahue described the current state of space science as healthy, but noted the problem of infrequent launch opportunities, a consequence of Shuttle delays and the phase-outs of ELVs. Dr. Donahue described the present institutional arrangement within NASA and the STS system coming on line as suitable to conduct planned space science missions effectively, although he admitted uneasiness about an orbiter fleet being limited to four orbiters. If changes are made, such as the addition of an operational charge to NASA's charter, they should not change the existing structure of the agency in a way that could impair support for space science. Under no circumstances should responsibility for space science be shifted from NASA to NSF. If a charter change is necessary to designate NASA's responsibilities in the area, then Donahue would support such change.

With respect to a space station, Dr. Donahue described the recently announced position of the Space Science Board. The Board, he said, did not view the space station, as currently envisioned by NASA, as having a strong space science requirement; thus, the need for a space station should be decided on grounds other than its usefulness to space science.

Dr. Donahue underscored the importance of international cooperative ventures in space, as they provide a valuable opportunity to undertake space activities that could not otherwise be afforded by the respective nations. U.S. commitments to international ventures should be fostered and strengthened.

In discussions with Rep. MacKay, Dr. Donahue characterized the current space policy advisory apparatus as adequate. Mr. MacKay stressed the need for early identification and foresight capability, and contemplation of issues by the Board in order that policy advice may be fed into policy discussions as early as possible.

Dr. Donahue endorsed the recommendations of the SSEC and the NASA Advisory Council to expand planetary exploration and exploration of the solar system, noting NASA's appropriate role in the area. These missions, however, should not be done at the expense of basic research.

Willis H. Shapley, Member, Space Applications Board

The Space Applications Board believes NASA's R&D role in space applications should be governed by the following general principles:

NASA should take the lead, along with other agencies and interests involved, in systematic reviews of existing and possible future applications of space. An advisory committee structured like the former National Advisory Committee for Aeronautics (NACA) should provide the formal mechanism for interaction among participants. NASA should conduct and support research and development of essential components and subsystems of space and ground systems for civil space applications, where such research and development is not being, and cannot reasonably be expected to be, conducted and paid for by the private sector or by the Department of Defense or another government agency.

NASA should conduct and support under cooperative arrangements with the private sector and other government agencies, systems tests, demonstrations, and experimental operations in cases where (1) potential benefits and users have been identified, (2) the private sector cannot reasonably be expected to pay the full cost, and (3) the application is not clearly within the mission of another federal agency.

NASA should be responsible for fostering the transfer of useful civil applications systems to the private sector or other government agencies except when such responsibility is specifically within the mission of another government agency. Mr. Shapley advised that NASA's role in the space applications area could be more crisply clarified, and emphasized the importance of NASA's continued work in research and experimentation, particularly in the materials processing areas.

Mr. Shapley views the current space policy advisory apparatus as sufficiently independent and working well, and voiced concern that the establishment of yet another advisory panel or board could build in inflexibilities.

As for the need for any amendments or adjustments to the NASA organic act, Mr. Shapley prefers that fine tuning be done through the annual authorizing process rather than through amendments to the organic act.

John Naugle, Director, Leasecraft Program, Fairchild Industries, Inc., and Former Chief Scientist, NASA

Dr. Naugle described the 1958 NAS Act as an excellent statement of national space policy which has stood the test of time, produced excellent results and should not be changed.

Dr. Naugle sees no lack of vision in the space sciences, but is concerned about the increasing time between scientific missions, which impedes the ability of scientists to explore new discoveries and ideas on a continuous basis. The United States cannot maintain a position of scientific preeminence if the period between missions remains 10-15 years. Dr. Naugle suggests breaking this cycle by increasing funding to accelerate the start of AXAF, SIRTF, SOT, UARS, and Planetary Explorers; by reducing the lead-time and cost of shuttle sortie missions and establishing permanent observatories and platforms in space to permit the same type of continuous observations and rapid response to new discoveries as the ground based astronomers have enjoyed.

Dr. Naugle discussed NASA's dual role in the commercialization of space. The first concerns arranging for a commercial entity to take over shuttle operations. While the Shuttle is not ready to be commercialized, in Dr. Naugle's view, when the time does come NASA will need to be sure that an adequate market exists to sustain a profitable business, that the company is technically competent, and financially sound, and that there is sufficient competition or adequate regulation to assure a reasonable cost of transportation to and from space.

NASA's role should be different in encouraging commercial activity in space by undertaking joint endeavors with private firms to assist in producing new products in space. Dr. Naugle views as essential the requirements that the product be producable in space, and that it be extremely valuable in small quantities, with markets in excess of $100 million annually. Pharmaceuticals, crystals, and exotic metals are examples of these materials. The most important thing NASA can do is provide cheap, reliable and predictable (by several years) transportation to and from space. While there will be other important responsibilities for NASA, Dr. Naugle views them as insignificant compared to the need to turn the Shuttle into a common carrier to and from space.

John Yardley, President, McDonnell Douglas Astronautics Company

Mr. Yardley believes the 1958 NAS Act is a sound statement to guide U.S. space policy for the next 25 years, with the possible addition of objectives regarding economic development.

Concerning NASA's role in the development and operation of future space transportation systems, Mr. Yardley warned of a catastrophe if there is complete separation of the R&D organization from operations. Mr. Yardley suggested that operations responsibility remain in NASA with an internal reorganization to lend greater separation between R&D and operations rather than have private enterprise manage shuttle operations. Mr. Yardley also recommended that NASA continue as the military's launch agent for the Shuttle.

In space applications, NASA should be concerned with basic research into areas that the private sector is unwilling to do and actively involve the private sector to assist in developing and bringing space products to market. Other government agencies could increase their involvement in developing space businesses. To do so, consideration should be made of instruments of policy which include export tax laws, tax incentives, proprietary protection and regulatory activity.

NASA's role in Federal space policy formulation, in Mr. Yardley's view, could be strengthened. This is in part a consequence of there being a large number of agencies involved in making space policy. NASA should also take the lead in international space policy formulation. In the commercialization area, NASA should facilitate commercialization and technology transfer, but not regulate.

In response to questioning from Chairman Volkmer concerning ways to reduce Shuttle costs, Mr. Yardley praised the recent contract consolidation at KSC, suggesting this combined with the learning process would help bring down costs. If current trends continue, Yardley predicted that the anticipated costs for 1988 should be lower than declared for the three prior years.

Mr. Yardley suggested the need for additional funding in the Space Applications area to reverse the effects of prior year decisions which deemphasized space applications. Space materials-processing basic research is one area which could be revitalized with additional funding.

Christopher Kraft, Former Director, Johnson Space Flight Center

In discussing the changes NASA has undergone during the last 25 years, Dr. Kraft emphasized the need for an agenda or plan of what the agency foresees as reasonable and responsible goals to be achieved in both the near and far term. Such a plan would be updated annually to reflect budget limitations, accomplishments, new developments and changes. Dr. Kraft emphasized that research establishments and industry sorely need a clearly defined planning process. According to Dr. Kraft, NASA should be in a position to describe where we're going; it will be up to the Administration and Congress to determine the rate at which it will be accomplished.

Dr. Kraft discussed the future operation of the Space Transportation System, saying it is neither practical nor desirable to turn the STS over to a commercial venture. The time to reconsider this is when NASA's operations are space based and DOD is independently operating its own Shuttle activities. For the time being, Dr. Kraft suggested NASA may want to consider a joint NASA/DOD program office for STS management.

Concerning STS versus ELV's, Dr. Kraft pointed out the way to make the STS cost effective is to increase its load factor and fly it as often as possible.

Dr. Kraft voiced concern about growing sentiment in government that in essence, says, "If the industry is so interested in space, why aren't they willing to pay for it?" Seeing this view as damaging to future uses of space, Dr. Kraft pointed out that the investments that would be required of industry to offset NASA's budget problems are far greater than any single industrial organization or industry group could provide. The return on the taxpayer's investment in space defies measurement, Dr. Kraft emphasized. The Government's investment in space is also essential to protect America's future position in world markets.

Dr. Kraft urged the development of an STS orbiter with extended mission capability to bridge what he views as extremely limited present on-orbit-stay time and initial operational availability of a space station. Dr. Kraft also described as inconceivable the shutting down of orbiter production, given anticipated commercial and military demands that will be placed on the fleet. The country's need for technology demands that we find an economically feasible way to keep orbiter production open.

The government needs to renew its commitment to getting a full measure of benefits from the Space Act. As Dr. Kraft noted, the legacy of Apollo is that the country can do anything it sets its mind to do.

Karl Harr, President, Aerospace Industries Association

Mr. Harr began by reminiscing on the way this country entered the space program when our long-standing assumption of technological supremacy was threatened by the Soviet Union. While it is likely that we'll never have the degree of national support for the space program we had in the post-Sputnick days, the spectre of international competition in space is a sufficient prod, and we can bring about a new consensus if we never lose sight of space offering us a three dimensional world.

Mr. Harr offered his idea of our future space program -- an advanced space operations capability and a strong space science program with particular focus on expanded research in space applications. In this context, the government should give priority to programs designed to reduce industry risk-taking, such as the joint endeavor agreements.

One of the most promising areas of space commerce, in Mr. Harr's view, is in satellite communications technology. NASA should continue to develop U.S. satellite technology to enhance their attractiveness in the international marketplace. NASA should also continue to develop technology for space-based land resources surveying, and give high priority to related remote sensing ocean observation systems. NASA should take a lead in industrialization through an expanded R&D program of orbital materials processing, as a counterpart to NASA's highly successful trail-blazing work in aeronautical R&D.

Mr. Harr described what he sees as needed to maintain U.S. leadership in space. To get there, we need to develop advanced technology toward a complete capability, to include:

- operation in space on a continuous basis;

- routine, repetitive operation in geosynchronous orbit as well as in low-earth orbit;

- ability to deliver and retrieve and repair payloads in low and high orbit; to deploy, assemble or construct large structures in orbit; to achieve efficiencies and economies by aggregating a number of payloads on large, Shuttle-serviced multifunction platforms in either low or high orbit; and to direct and monitor these space operations from a central hub -- a space station.

The country needs a firm commitment to finish what we started. It will be technically feasible, not demanding technological breakthroughs of Apollo dimension. The key questions will be financial, and will necessarily involve a strong government-industry partnership. Achieving this capability in space will expand our technological base, assure U.S. leadership in science and technology, and position us to meet the anticipated space challenge from abroad.

Jerome Simonoff, Vice President, Citicorp Industrial Credit, Inc.

Mr. Simonoff's major thesis is that space programs should be designed and operated for transfer to the private sector whenever possible. However, the costs of these activities are so great that NASA will have to maintain a continuous involvement in many programs. According to Mr. Simonoff, the Federal Government must participate to: (1) push technology when costs are greater than private industry is able to bear; (2) transfer "unclassified" defense developed technology to the private sector, (3) provide industrial infrastructure support to lower entry level costs into space for entrepreneurs.

Mr. Simonoff pointed out that the high cost alone does not limit investors in space activities, but the kind of activities that can be undertaken in space are due to limited risk appetites of financial organizations. NASA may want to become an "insurer of last resort" and offer launch and life insurance in case of high risk at rates higher than the highest quoted rate. NASA would be replaced as the insurance market grew.

Mr. Simonoff sees four major financial issues related to foreign competition: the availability of subsidized financing, involving the use of Eximbank cross-border leases to lower the effective interest costs for satellites, which is of greatest relevance to marketing space shuttle services; supplementary launch financing, limited to NASA supplied launch services; countertrade or offset capability; and cross subsidization of products such as in the 30/20 GHZ area.

Mr. Simonoff pointed out that most early stage investments are under $15 million, which is less than the cost of a shuttle ride. What the government can do is provide an infrastructure to reduce the costs of doing things in space, such as technology procurement, providing low cost accessible transportation, space platforms, space station and low-cost, easily available information on nonsecurity-related developments.

Simonoff suggested the private sector may be able to operate the Shuttle in 25 years. Along these lines, the addition of language in the organic act concerning NASA's promotion of commercialization could be helpful.

In discussing international Shuttle promotion, Mr. Simonoff called inconceivable the idea that any buyer organization planning to invest monies in a space project would not already be aware of the Shuttle's capabilities. The most important aspect of international marketing and promotion, then, is the ability of NASA to help users understand how to use the Shuttle, and assure them that NASA can deliver on its promises for a timely and economical launch. Simonoff said he sees NASA as relatively responsive to users' needs and, in spite of a high degree of promotional professionalism and attractive financing incentives by Arianespace, NASA has won most competitions against Arianespace. Competition has made NASA more responsive to user needs. In the future, NASA will be required to respond to business as well as technological issues.

Concerning cost burden, Mr. Simonoff recommends that NASA absorb costs necessary to minimize the transportation costs of a payload, including payload integration, flight qualification, and costs that require unique instrumentation on the ground for which NASA has developed an infrastructure. Private industry should bear the cost of payload development with regard to design and fabrication, and fabrication and transportation costs with regard to revenue producing applications. Cost sharing should not be specified in the organic act at this time, since issues concerning space commercialization are still surfacing.

38-705 O - 84 - 4

James M. Beggs, Administrator, NASA

Mr. Beggs testified to the soundness of the 1958 NAS Act, and indicated it should be preserved in essentially its present form. If changes or clarifications are needed, they can readily be accommodated through the annual authorization process.

NASA's highest priority at present is to make the space transportation system fully operational and cost effective in providing routine access to space. With the Shuttle providing routine access to space, NASA has initiated plans for space station development. Any effort to separate R&D from STS operations management would be premature at this stage.

NASA is also working to expand opportunities for private sector involvement in civil space activities, including privatizing the operation of ELV's.

Mr. Beggs discussed NASA's relationship with other agencies involved in space. In Mr. Beggs' view, NASA's relationship and cooperation with DOD is sound, and needs no special office or arrangement to improve the relationship. Mr. Beggs disagreed with suggestions that have been made to establish a NASA/DOD Shuttle management office, noting that any problems between the two agencies concern accounting and not technical questions. Relations with NSF are also growing in importance, particularly in the earth sciences, and Mr. Beggs views as essential the setting up of a coordinating activity.

In discussing the current space policy advisory apparatus, Mr. Beggs characterized such advice as ample and sufficiently independent to preclude the need for yet another advisory body, such as the former National Aeronautics and Space Council.

Mr. Beggs did express concern over NASA's ability to do long range planning, currently inhibited by annual budgeting procedures. NASA is currently talking to OMB about how programs might be set up on an 8-10 year basis.

Concerning previous suggestions by another witness, Mr. Simonoff, that NASA provide launch and liability insurance of last resort, Mr. Beggs responded that he believes private underwriters are able to provide sufficient coverage. Currently, NASA sees both a need and an effort by the insurance industry to increase available insurance capacity to meet projected growth in insurance requirements.

Thomas O. Paine, Former Administrator, NASA

"If it ain't broke, don't fix it," is the principle Dr. Paine would follow in looking at the 1958 NAS Act, which, in his view, has very well stood the test of time. The general policies that it expresses for U.S. civilian space programs are as good today as they were twenty-five years ago.

If improvements could be made, Dr. Paine suggests NASA do more long range planning. A move to multiyear procurement, a new procedure undertaken by the U.S. Air Force, could result in greater economies. NASA should also institute formal long range planning, looking ahead about 25 years, in three eight year segments. Long range planning would strengthen interactions among government, industry, and academia, as well as improve our international cooperative programs. Long range planning would also contribute to lower-cost Shuttle transport, improve commercialization and benefit planning to explore the solar system.

Dr. Paine views the need for a fifth orbiter as apparent, but sees the same not as a separate question but a consequence of requirements brought about by moving ahead with a strong space program. The key questions concerning the commercialization of space will be related to timing and institutional structure. Dr. Paine also added that, in his view, industry is reassured by the knowledge that our basic laws will not be changed, i.e., leaving the Space Act in its present form is a good idea and one that should reassure investors. As an investor in space companies, Dr. Paine believes commercialization looks promising and that NASA is on the right track.

Concerning the management of Shuttle operations, Dr. Paine pointed out the question is related to where the Shuttle program is technically:

> "If you regard the Shuttle as the DC-1 of space and you are really going to get commercial when you get the DC-3, then it would be much better to keep the Space Shuttle perhaps in a separate organization but within NASA . . .
>
> You can do a much better job of understanding what your costs are by putting some kind of a fence around it and operating it as through it were the airline and the NASA R&D was the Boeing that was going to develop the next airliner."

James C. Fletcher, Former Administrator, NASA

Dr. Fletcher identified budget cuts to NASA programs over the years as the major impediment to the agency's ability to plan successfully for the long range. In fact, Dr. Fletcher feels NASA is one of the most future-oriented agencies. Budget stops and re-starts have also resulted in increased costs to programs. Despite these interruptions, Dr. Fletcher recommended that NASA should develop a long range plan, containing dollar estimates, and such a plan should be agreed to by the Congress and Executive Branch.

Dr. Fletcher discussed the NASA-DOD relationship, observing that the major potential problem is that NASA not be given responsibility for a DOD project because of NASA's expertise. If NASA can make a contribution to defensive technologies program, then DOD should pay for it. Otherwise, utilizing NASA's resources would detract during the next 10-15 years from the agency's primary missions of space exploration and commercialization.

Dr. Fletcher closed by suggesting NASA's mission for the next twenty-five years: space exploration and occupation.

Robert A. Frosch, Former Administrator, NASA

Dr. Frosch began by describing his view of NASA's future mission -- investigation of the universe, exploration and development of means to use the solar system, study of earth from a global and planetary point of view, and development of technology for these purposes. The development of this coming technology can begin today, through industrial robotics and artificial intelligence. Our efforts should also be a combined enterprise of human and machine use, rather than a competition between the two. A mission unique to NASA concerns the ability to take a global view of planet earth. A system of continuous remote sensing of environmental, agricultural, natural and industrial events, should be a NASA imperative, both national and international in scope. The process of changing the remote sensing data into useful information provides a clear and straight-forward route to commercialization. It will be more difficult to commercialize the satellite systems that collect the data, since the U.S. government is the primary customer.

Dr. Frosch observed that NASA's difficulties do not lie in the ability to make plans, but in turning plans into reality by finding some way to have consistent budget support. However, a long range plan of mission directions and budgetary support would be helpful as a reference point.

Dr. Frosch described the space station as the future and key to NASA's long range mission. The question of need for a fifth orbiter is secondary, and should be decided on the basis of need as we proceed toward building a space station.

Dr. Frosch endorsed the idea of separating shuttle operations, budget, manpower, etc., from R&D within NASA, otherwise "fire drills" in operations will hurt R&D, but Dr. Frosch saw no particular advantage in the creation of a separate independent entity to manage shuttle operations. Separation of the two may also help reduce shuttle costs, along with other organizational and contractual mechanisms.

Likening NASA's new role to an investor, or private corporation, Dr. Frosch suggested NASA explore and identify new technologies, find new customers and assess risks.

Dr. Frosch warned against amending the 1958 NAS Act, recalling previous efforts to do so as nightmarish. Perfectly clear and simple reasons frequently go awry, and could destroy what Dr. Frosch sees as a very elegant act.

III. SUMMARY OF MAJOR ISSUES

A number of major issues that were discussed in the hearings are summarized in this chapter. The scope of the hearings did not enable the Subcommittee to explore all issues in equal depth. However, most of the issues are of continuing relevance and concern and will be pursued not only in discussions concerning the fiscal year 1985 budget request, but also in years to come.

The following issues are discussed:

A. Adequacy of the Policy Objectives of the National Aeronautics and Space Act of 1958
B. Need for Long Range Planning
C. Adequacy of Space Policy Advisory Apparatus
D. Management of Shuttle Operations
E. NASA's Role in Commercialization
F. NASA and National Security: the NASA-DOD Relationship
G. Space Science: Challenges and Opportunities
H. International Cooperation in Space
I. NASA's Next Step -- the Space Station
J. Program Balance at NASA
K. Potentials for a Strong Space Applications Program
L. Need for a Fifth Orbiter

A. Adequacy of the Policy Objectives of the National Aeronautics and Space Act of 1958

A major purpose of the October hearings, as Chairman Harold Volkmer explained, was,

> "to review the National Aeronautics and Space Act of 1958 and the basic policy objectives contained in the Act which have served to guide our Nation's civilian space program under NASA's stewardship for the last 25 years. Our purpose is to determine the adequacy of that space policy for NASA's next 25 years."

According to most witnesses appearing at the hearings, the 1958 National Aeronautics and Space Act is not only a sound piece of legislation that has stood the test of time, but is, as Dan Fink, Chairman of the NASA Advisory Council, described, "a remarkable piece of legislation . . . that remains today a strong guide with respect to national purpose and policy in aeronautics and space and the basis for the missions of NASA."

Several witnesses suggested that the Act's policy objectives should reflect the economic and commercial aspects of the space program. Most saw the value of strengthening the Act's economic perspective as an enhancement to complement NASA's current and future commercial activity in space; the absence of such language was not viewed as inhibitive to the agency in any way. Rep. Robert Walker, a Member of the Subcommittee, testified that the U.S. should aggressively pursue commercialization of space, and urged that NASA's involvement in the commercial arena be given added visibility in the Act's policy objectives. Rep. Walker recommended that specific language be added to to the Act both to recognize and stimulate NASA activity in the area.

The expanding character of the space program, marked by increased private sector interest in space and growing international competition, may warrant a revisiting of the goals and policies articulated in the Act, according to John Gibbons, Director of the Office of Technology Assessment. Although he views the Act as "permissive", Dr. Gibbons observed that "a civilian space program based primarily on scientific, engineering and aerospace imperatives can no longer be considered appropriate."

Most witnesses, however, testified that they found the Act to be flexible and uninhibiting to any future mission NASA might pursue. Administrator Beggs testified:

> ". . . the Space Act is structurally sound, well-suited to support today's needs. Changes in emphasis and mission can be readily accommodated through the annual authorization process. It serves to avoid speculative structural modifications which could turn out to be unnecessary or prove to have been wrong."

Dan Fink concurred and elaborated: "This process of change will continue and I would be concerned that amendments to the Act could reduce our flexibility to respond to this unpredictable but inevitable process."

Dr. Thomas Paine, former NASA Administrator, commended the longevity of the Act as reassuring to investors in future commercial space projects by pointing out that,

> "one of the things that encourages industry to make investments is a feeling that they understand the basic laws are not going to be changed."

---

[7] An amendment to the National Aeronautics and Space Act to direct that our national policy would be to "seek to the maximum extent possible the fullest commercialization of those programs which have been proven by research and development."

Finally, several witnesses testified to the need for a recommitment to the Act's policy objectives. Karl Harr testified:

> "NASA's broad objectives, as expressed by its charter, are as valid today as they were 25 years ago. What we need is a renewed national dedication to [NASA's original] objectives, recognition of the opportunities for public benefit that space affords, and the national will to pursue those objectives."

Chris Kraft echoed Mr. Harr's remarks: "The need of the '80s is a renewal of commitment on the part of the U.S. Government to assure that the nation gets a full measure of benefits from the Space Act."

Rep, George E. Brown, Jr., Member of the Space Science and Applications Subcommittee, offered a starting point: "We need a new, far-sighted application of the policies in it to make it effective and a consistent budgetary approach to make it work."

B. Need for Long Range Planning

The Subcommittee on Space Science and Applications has repeatedly stressed the need for a long range emphasis in space policy:

In 1981: "NASA should propose to the Congress a set of long-term goals which will reflect a balance between space science, applications, and space transportation activities."[8]

In 1982: "If the United States had a better, more certain, long-range vision of where it is going in space, that is, if the Nation had a clear view of its desired future in space, then it would be possible to work efficiently and effectively toward that desired future. Specifically, a clear vision of the desired future would make it easier to identify criteria for program decisions."[9]

This continuing need for a long range view was expressed by many witnesses at the October 1983 hearings.

Rep. George E. Brown, Jr., describing the changing character of the space program as a "space revolution", emphasized the complexity of space issues warrants the need for a long range view of space goals to complement the yearly review of NASA programs, which, he added, "do not in themselves make policy." Mr. Brown encouraged "joint congressional committee reviews of space programs and policy formulation in those areas where there is overlap in committee jurisdictions."

Inhibiting a long-range planning effort, most witnesses agreed, is the current system of annual budgeting, despite Mr. Beggs' estimation that the predominance of NASA's activities take 7-8 years to accomplish.

Chairman Don Fuqua pursued with several witnesses how long-range planning might be implemented on a more sound basis. Most agreed that in spite of annual budgeting procedures long-range planning could be improved.

Chris Kraft called for NASA to create an agenda for the U.S. space program:

---

[8]U.S. Civilian Space Policy, committee print, Serial C. U.S. House of Representatives Committee on Science and Technology, 97th Congress, April 1981.

[9]Future Space Programs: 1981, Committee Print, Serial Z, U.S. House of Representatives Committee on Science and Technology, 97th Congress, May 1982.

> "The NASA plan should be a projection of what the agency foresees as reasonable and responsible goals to be achieved in both the near and far term, updated annually to reflect budget limitations, past accomplishments, new developments and changes brought about by the Nation's needs. The government should make it very clear that NASA is expected to produce such a plan and that those seeking government expenditures or support must coordinate their efforts through NASA."

James Fletcher, former NASA Administrator, added that the plan should have "dollars in it and be agreed to by both the Legislative Branch and the Executive Branch."

Thomas Paine, former NASA Administrator, emphasized:

> "the most important thing to recognize about a long-range plan is [that] it is not a straight jacket...to march through for the next ten or twenty years. Rather, it is the long-range context within which you put your next year's budget."

Dr. Paine discussed some of the advantages of taking a long-range view of space, including "better designs at lower cost, better program performance", and the ability to convey greater confidence and commitment in international cooperative programs in space.

Karl Harr, on an historical note, pointed out that we have been quite successful up to now without a self-initiated plan:

> " . . . the United States did not decide to embark on a national space program as a consequence of a careful and orderly planning and policymaking process. Quite the reverse. We were virtually dragged into space kicking and screaming by Soviet initiatives and successes . . ."

Another former NASA Administrator, Robert Frosch, perhaps most aptly described the difficulties in formulating a workable long-range plan.

> "The difficulty with planning in NASA has never been the problem of making plans. Indeed, there is always in the Agency a family of long-term plans . . . The difficulty has been in turning those plans into reality by finding some way to have a continuity of budgetary support which makes it possible to carry out the plans. I think the difficulty has always been that no President, no Office of Management and Budget, and, really, no Congress, wishes to tie its own hands as to its future budgetary activities."

C. Adequacy of Space Policy Advisory Apparatus

A pervasive concern at the hearings was the health and adequacy of the space policy advisory apparatus. Two aspects of space policy advice were discussed; first, NASA's role and voice in space policy formulation, and second, the general functioning of the current space policy advisory apparatus.

Concern over NASA's role and voice in space policy has evolved, it appears, as a result of the growth of increasingly complex space issues which in turn has brought new players into the arena. For instance, although NASA's primary mission is space, many other Federal agencies share concern and interest over matters involving U.S. space activity. As other agency voices have become more vocal in space policy formulation, there has evolved a consequent need for NASA to assume a stronger role in U.S. space policy formulation.

John Yardley voiced concern that NASA may be viewed by other agencies as "advocates for space", inhibiting the agency's ability to assume a more significant role in policy formulation.

Chris Kraft urged a reemphasis on NASA's chartered responsibility "for developing the country's efforts in space," through the development of a national space plan. Insuring a strong voice for civilian space programs might be achieved through the formation of a civilian Senior Interagency Group (SIG) on Space, according to the testimony of Rep. George E. Brown, Jr. Rep. Brown suggested the group be set up as a counterpart to the currently established SIG chaired by the President's National Security Advisor. An alternative approach, Rep. Brown explained, would be the co-chairing by NASA of the current SIG. However, in the view of John Gibbons, the

> "SIG's membership is too restricted properly to address the broad set of civilian concerns in space . . . military and intelligence considerations quite possibly do unduly influence civilian space policy issues and . . . other Federal civil agencies with space interests should be made full participants."

Despite the need for better coordination and balance among the Federal agencies involved in space policy, most witnesses agreed the problem does not warrant reestablishment of the National Aeronautics and Space Council (NASC) which was set up by the 1958 Space Act to promote conflict resolution and better coordination among agencies engaged in space activities. Rather, concern seemed to focus on ways to enhance NASA's stature within the Executive Branch.

Witness testimony revealed a greater concern for the current health and functioning of the space policy advisory apparatus. Rep. MacKay raised the question at the hearings:

> "What is the assurance that we have today that the administrator in NASA, the program directors, the executive will give adequate priority to those programs? I guess I am asking whether there is a sufficient advisory apparatus and whether the advisory apparatus has enough priority so that we, the Congress, in the role of a board of directors, can feel comfortable that new voices are being heard, and Congress can get independent thinking on priority policy issues?"

John Gibbons echoed this concern:

> "With the demise of the National Aeronautics and Space Council ten years ago, there is no longer any congressionally established and broadly representative professional body that is charged with providing guidance on national space policy. Decisions are therefore often made ad hoc with insufficient regard to our nation's long-term interests and postures in space."

The OTA has recommended a "high-level, multirepresentative body to recommend goals and objectives for the overall U.S. space effort." Such a body could take several forms:

* A new version of the National Aeronautics and Space Council (NASC), to include public and private representation.

* A Presidential or national commission, composed of representatives from all major communities in space.

* A statutory Space Advisory Board, responsive to both NASA and Congress. As envisioned by Rep. George E. Brown, Jr., the Space Advisory Board could be modelled after the EPA Science Advisory Board[10] or the Department of Energy's Research Advisory Board.[11]

Rep. Brown elaborated:

> "It could perform a visionary function for Congress and for NASA and help us to structure a strong and coherent space program. If we do not actively seek outside advice, we will tend to make policy and programs on a closed loop between NASA, the Hill and special interest groups."

---

[10]Established pursuant to Section 8, P.L. 95-155.

[11]Established by Charter.

D. Management of Shuttle Operations

The Subcommittee, in holding its hearings, was also interested in exploring NASA's future operational responsibilities of the Shuttle and other space transportation systems. As the Space Shuttle makes the transition from development to full scale operations, a clearly defined role for NASA beyond the R&D phase remains undetermined.

Most witnesses agreed with Administrator Beggs that NASA's highest priority goals should be "to make the Space Transportation System fully operational and cost effective in providing routine access to space."

Discussions concerning management of the Space Transportation System focused on the recommendations of the NASA Advisory Council on the Study of the Mission of NASA,[12] which were released at the hearing. The council reviewed several options for managing STS Operations, including commercial, DOD, and new agency management. The NASA Advisory Council concluded:

> "In light of the present small size of the Shuttle fleet, its lack of maturity and high cost of operation, the lack of DOD interest in assuming full operating responsibility, Shuttle operations should remain within NASA. However, a continuation of the current STS management approach might create a serious diversion of NASA resources and attention from its more traditional roles of aeronautics and space R&D and space exploration and experimentation. The report recommends that a new NASA organization, within NASA and reporting to the Administrator, be created to manage Shuttle operations and utilization and that, within this new NASA entity, manpower, finances, and facilities be fenced or confined to serve only these objectives. This Shuttle operations organization would be responsible for marketing and sustaining engineering support but not for future development activities."

John Yardley urged the separation not be too great:

> "There is a grave danger of catastrophe if we completely separate the R&D organization from the operation organization. I feel the best solution for the next decade is to leave the operations responsibility with NASA, but to internally reorganize to have some greater separation than exists today.

---

[12] NASA Advisory Council, Study of the Mission of NASA, October 12, 1983.

> "You've got to carefully balance the operator's ability to do those things which he needs to do to operate properly without having to be the victim of too many engineers making too many changes.
>
> "On the other hand, he's got to have that technical expertise because this is a very sophisticated machine. So, to do it with fenced manpower and all sounds a little strong."

Chris Kraft concurred with Mr. Yardley:

> "It sounds like a great idea that we separate this thing off as an organizational scheme, but it can't work because you need the technical competence of the NASA organization to maintain the direction of the space transportation system. It's going to continue to have technical issues that must be solved, and you're going to have to depend on those people that have the technical know-how to do it. A separate budget might be provided to NASA if that helps them."

Mr. Beggs noted that, although

> "it is premature to think in terms of separation of the R&D from the operating capability at this time, it is not too early to start thinking about how that ought to take place, whether it should take place as the report states, setting up a separate organization within NASA or whether it should be a separate organization outside of NASA, to do that operation."

Chris Kraft also recommended a joint NASA/DOD program office for STS management be considered in the near future to accommodate future scientific and military uses of the Shuttle.

According to most witness testimony, although it is premature to consider commercial operation of the Shuttle, the private sector should early-on be allowed and encouraged to contribute to portions of the systems where appropriate. However, Rep. Robert Walker suggested the time is not premature to consider commercializing Shuttle operations:

> "Do we commercialize the Shuttle and allow NASA to once again become a research and development agency on the frontiers of science, or do we allow the Shuttle, like a full grown chick, to remain in the nest?"

The NASA Advisory Council also recommended that NASA, in determining launch and service pricing for STS users, make allowance for the national resource character of the STS and that NASA's future policy reflect an incremental, or institutional, cost basis, rather than full recovery of recurring costs.

Dr. James Fletcher said he believes operational costs are "too high," and urged cost reduction as a "high priority because the operational cost of the Shuttle that is not going to be reimbursed is going to reflect back and subtract from other programs."

Several witnesses suggested how the STS might be made cost-effective. Dr. Kraft testified:

> "The one sure way to make the STS cost-effective, as in any transportation system, is to increase its load factor and assure that it is flying as often as the fleet size will allow."

Thomas Paine pointed out the relationship between cost and the technical status of the Shuttle program:

> ". . . at the present time it would be much better to keep the Space Shuttle in a separate organization but within NASA because NASA is going to have to do a lot of work in engineering and development to really get those costs down . . . you can do a much better job of understanding what your costs are by putting some kind of a fence around it and operating it as though it were the airline and the NASA R&D was the Boeing that was going to develop the next airliner."

Finally, significant cost savings are expected to be realized following the consolidation of launch processing contracts at Kennedy Space Center and Johnson Space Center. Witnesses urged that other organizational and contractual mechanisms be sought to reduce operational costs.

E. NASA's Role in Commercialization

Although the Subcommittee has undertaken a separate and extensive examination of commercialization issues,[13] and will continue to do so, the extent to which commercialization issues were discussed at the October hearings warrants attention in this report.

Clarifying NASA's role in commercialization was the central thesis of testimony presented to the Subcommittee by one of its members, Rep. Robert Walker:

---

[13] Space Commercialization, Report of the Subcommittee on Space Science and Applications, 98th Congress, 1st Session, Serial R.

> "There are some who tell us that we must approach commercialization in space with caution; that we should study and examine all the alternatives with great care; that we should commission the Administration to undertake a major study of all the ramifications of potential commercialization and have them report back to the Congress. . . I would submit that had Queen Isabella demanded such a study before she pawned the crown jewels, Christopher Columbus might still be waiting for approval.
>
> "We must decide first what the roles should be for NASA in our future. For 25 years NASA has been on the cutting edge of technology. They have always been advancing the frontiers of science, and that is exactly the role which most Americans feel that NASA was designed to fulfill.
>
> "I suggest that we amend the National Aeronautics and Space Act to direct that our national policy would be to ". . . seek to the maximum extent possible the fullest commercialization of those programs which have been proven by research and development."

Most witnesses saw the value of strengthening the Act's economic perspective as an enhancement to complement NASA's current and future commercial activity in space; nevertheless, the absence of such language was not viewed as inhibitive to the agency in any way.

Responding to Rep. Walker concerning whether the Space Act should be amended in this regard, Mr. Gibbons commented on the effect of organic language giving NASA a specific charge in the commercialization area:

> "By all accounts, the Space Act is permissive of almost any sort of activities that NASA might choose to undertake. However, the particular directives which it specified, without exception, have to do with the promotion of the physical and life sciences, the development of advanced technology and launch capabilities, and the exploration of space. Thus, the Act works against commercialization only to the extent that NASA (or any other Agency in the Executive Branch) is not specifically charged with seeing that it takes place.
>
> The Act could be revised to meet this objection by including language charging NASA (or some other Executive Branch office(s)) to provide mechanisms for moving the Federal Government . . . into the prompting of the private sector to provide economically attractive goods, services, and processes in a sensible, expeditious manner."

What should the Federal Government, and NASA, be doing to encourage commercialization? Most witnesses appeared primarily concerned with NASA's role in providing access to space. According to the witnesses, the most important thing NASA can do is establish predictable and low-cost, reliable transportation to and from space. John Yardley emphasized the importance of commitment to these goals:

> "One of the most important areas to the potential space entrepreneur is that of stable, long term government policies in the launch areas of cost, services, priorities, capacity, etc. Without a firm long term federal policy supported by Congress and the executive branch and backed up by deeds, . . . the risks are too high, and the space businesses will languish. New Space Act language setting this long range policy, together with authority to permit NASA to contract on long term multi-year bases for launch and other services (including damages for failure to perform) would go a long way toward solving this problem.

Jerome Simonoff testified that "space programs should be designed and operated for transfer to the private sector whenever possible, although, he continued, "whenever possible" means that private sector contol "is not necessarily desirable in all cases."

Jerome Simonoff suggested what might be done to alleviate the major barrier to entrepreneurs, that is, the high cost of doing business is space. The government should: (1) push technology when costs are greater than private industry is able to bear (for example the 30/20 GHZ communication technology), (2) transfer "unclassified" defense developed technology to the private sector, and (3) provide industrial infrastructure support to lower entry level costs into space for entrepreneurs.

According to Mr. Simonoff, NASA should also "borrow an idea from the Federal Reserve System and become an 'insurer of last resort'. Simonoff elaborated:

> "NASA, subject to its acceptance of a particular contract, based on its own technical risk analysis, would offer launch and life insurance to cover shortfalls from the commercial markets at premium rates higher than the quoted rate.
>
> "NASA would be there supplying insurance unless the insurance market grows, and as the market grows, then NASA would be replaced and there would be no serious competition between the government and the commercial role in supplying insurance."

Mr. Simonoff emphasized that this would be more effective in reducing the risk of commercial ventures than would NASA's providing up-front seed money, an idea discussed by Mr. Beggs.

Witness testimony also focused on the importance of NASA being responsive to business as well as technological issues in developing commercial space. John Gibbons described this as requiring an "attitude change" on the part of NASA's scientists, engineers and managers, as commercialization will affect a "culture which has been inculcated through years of education and practice."

Institutional changes could also be effected to encourage space commercialization. Several witnesses recommended that NASA be designated the lead agency in facilitating commercialization, although most agreed NASA should not be given a regulatory role in the area. John Naugle explained:

> "NASA should be designated the lead agency for R&D technical activities associated with space commercialization. Such a step would not only emphasize the importance of NASA's continued R&D activity in areas involving commercial potential, but also encourage a commerial orientation to the agency's R&D planning and activities."

NASA could also consider new internal institutional arrangements which, in Rep. George Brown's view, would help turn around our "inability to define and carry out the process of commercialization, and help promote a conceptual framework allowing us to take reasonable action." Rep. Brown recommended the establishment of a separate and enhanced Office of Space Applications and Commercialization.

John Naugle recommended that NASA establish a Commercial Affairs Office, similar in concept and responsibility to NASA's Office of International Affairs to provide a single point of contact in the agency and a rapid and uniform response to commercial initiatives and to encourage commercial activity.

Mr. Beggs emphasized NASA's awareness of the importance of institutional as well as technical mechanisms, reflected in the agency's undertaking of (1) a combined aerospace and nonaerospace industry research liaison to advise NASA on appropriate policies, research priorities, and experimental facilities to support U.S. industry in space-related commercial ventures, (2) co-sponsored NASA/industry research programs at universities and research activities, and (3) an expanded NASA space experimentation program in which industry and university researchers will be the principal investigators.

In addition, NASA will try to provide commercial space venture start-up risks by making experimental facilities available; entering into joint endeavor agreements; and establishing easier and more timely access to the Shuttle for commercial payloads.

According to Messrs. Yardley and Simonoff, NASA could also step up its "marketing" role, and enhance those educational processes needed to get product manufacturers and potential users educated, aware and involved in using the Shuttle and the space environment.

Finally, some discussions were directed to the turning over to the private sector operation of systems NASA has developed. To do so, according to John Naugle, "NASA would have to be sure of an adequate market to sustain a profitable business, that the company is technically competent, has adequate financial resources, and that there is either sufficient competition or adequate regulation to assure a reasonable cost of transportation to and from space."

Rep. George Brown, Jr., testified,

> "NASA should clearly have the option of operating a program as a commercial demonstration, up to the point where there is a clearly defined market or other arrangement which will allow it to move under reasonable conditions to the private sector."

Rep. Brown continued:

> "Defining the role in fields such as advanced R&D between the government and a monopoly private entity is extremely difficult. It leads me to conclude that we would do best in terms of commercialization when we do not create monopolies but instead have an active, competitive market, and that the circumstances need to be very carefully studied in order to make sure that we maintain the proper relative amount of effort in the long-range R&D which is so essential in a rapidly changing field."

According to Tom Paine, "the most critical questions will be . . . timing and institutional structure. These two things will be different for each case and will require very good judgment indeed."

Concurring, Bob Frosch added:

> "we frequently hear expressed the idea that a brand-new . . . technological idea simply has to be thrown out into the market and that will test whether it is a good idea. Ideas do not sell themselves, they need champions and they have to be worked on."

F. NASA and National Security: The NASA-DOD Relationship

Recent concern has surfaced concerning the blurring distinction between military and civilian activities in space. The National Aeronautics and Space Act of 1958, Sec. 102 (b) calls for separate, but coordinated civilian and military programs. Whether organic act changes are warranted was discussed at the hearings.

Rep. George E. Brown, Jr., voiced concern about a blurring between the civilian and military space programs, marked by an annual military space budget in excess of NASA's budget and a substantial proporation (about 25%) of NASA's budget which can be attributed to military activities. According to Rep. Brown, this trend is

> "contributing to the reversal of the tradition of openness that characterized the first 25 years of the U.S. space program.
>
> "Some may want to see NASA become a support agency for the military. Some may want no interaction at all, although I know of no strong opposition to cooperation on some levels with the military. Regardless of the individual beliefs that we hold, we cannot afford to ignore military and civilian interaction and conflict in space or we will surely deal ourselves out of a major emerging policy debate."

Mr. Winn asked Mr. Beggs if he felt there was a need to clarify jurisdiction between NASA and DOD in the NAS Act.

Mr. Beggs: "No, I do not. . . . we have pondered quite a lot here in recent months the question of militarization and the increase of the military activities in space. We have a very good working relationship with the military. We exchange views quite frequently with them. We have a Coordinating Board which . . . works well. We know what they are up to. They know very well what we are doing. Where cooperation has been desired on their part, we have generally cooperated with them. Where we have needed support from the military, they have given it. So, I do not think we need any either expansion or restrictions put on that relationship."

Although the NASA Advisory Council did not address the NASA-DOD relationship, the Mission of NASA Study recommendations did include that "NASA's role should evolve to comparability with its role in aeronautics; namely, it should be supportive of total national requirements, not just Agency needs." Mr. Fink explained that this would involve greater support by NASA of military space activities.

John Yardley urged that NASA continue to act as the military's launch agent for the Shuttle, and warned that splitting Shuttle operations into civil and military programs would be very costly: "If the military took over the system, I believe the commercial use of the Shuttle would be stunted, if not destroyed."

Chris Kraft recommended a joint NASA/DOD Office be established to manage shuttle operations. Mr. Beggs disagreed:

> "I do not think it is necessary nor, indeed, desirable. The problems we have with DOD lie usually in the areas of accounting rather than technical."

John Gibbons gave his views on where he thought coordination was needed:

> "In OTA's view, what may be needed is not a clear day-to-day relationship between civilian and military space managers, but better coordination at the Presidential and Congressional Committee level between the civilian and military space programs, especially in the face of increasing military space appropriations."

John Gibbons also identified likely potential consequences of the changing relative magnitudes of the civilian/military space programs: first, this country's commitment to the development and peaceful use of outer space may be viewed as weakened. In addition, NASA may have to compete with DOD for high quality manpower. Mr. Gibbons elaborated:

> "U.S. diplomacy with respect to space hinges on maintaining two separate and distinct space programs: military and civilian. Although there are and will continue to be many areas of overlap between the two programs, the civilian, publicly funded program must neither be, nor be perceived to be, a cover for military efforts.
>
> "In some respects, a buildup of military space-related research and development could contribute to keeping the supportive 'infrastructure' for the civilian space program in place, whatever the relative budget priorities between the civilian and military programs during a given fiscal year. However, if the military space program were to expand too rapidly, and/or if the civilian space program does not contain important technological and other challenges, there is a danger that it could drain personnel and resources from the civilian program."

On the later point, Chris Kraft offered a different perspective:

> "The legacy of Apollo is that the country can do anything that it sets its mind to do. Frankly, those young [people] who are out there are more worried about whether they're going to have a place to go and a place to work.

> "If the young people of this country knew that there was a great future in space, you would see people flocking to the universities to take the courses necessary to provide them the education to get there."

Finally, several witnesses addressed the implications for NASA of a new space weapons program. They agreed that NASA should not be required to fund a Defense space weapons program. James Fletcher, who recently headed a task force reporting to DOD concerning the space weapons research program, added:

> "I think the main thing we have to watch here is that NASA does not get stuck with some program that the military wants very badly because they believe that NASA has the expertise. I think that would detract from its [NASA's] main purpose over the next ten or fifteen years, which ought to be exploration of science and commercialization."

G. Space Science: Challenges and Opportunities

The importance of space science to the NASA mission was strongly evident through discussions at the hearings. The range of issues discussed included new areas for expanded NASA activity, federal organization for space science, the aggravation of infrequent launch opportunities for space science missions and opportunities for international cooperative activity.

Space science concerns received considerable attention in the NASA Advisory Council's "Mission of NASA" Study, on which Dan Fink testified. The Council recommended NASA's leadership and vigorous pursuit of "exploration of the solar system with the eventual goal of utilizing the resources and knowledge of space for human benefit, and examining our own planet from a planetary perspective, one that will provide greater and fuller understanding of the processes involved in global surface and atmospheric changes important to living systems."

Notably, the Council's recommendations represent an enhancement from those made by the Solar System Exploration Committee[14] (SSEC) of the NASA Advisory Council earlier in the year. (The SSEC recommended a $300 million annual "core" program to support planetary exploration.)

Tom Donahue, on behalf of the Space Science Board, endorsed the proposals, indicating his hope for their inclusion in the FY85 budget. Dr. Donahue continued:

---

[14] Planetary Exploration Through Year 2000 - A Core Program, Report of the Solar System Exploration Committee of the NASA Advisory Council, Washington, DC 1983.

> "In the case of the studies of global change from space, it seems to me that NASA has a fundamental role to play here. Such a program would form a key element in an international program such as the International Geosphere/Biosphere Program now being considered by the National Academy of Sciences. Missions like the Upper Atmosphere Research Satellite, the Ocean Topography Exploration Mission (TOPEX), and the Geodynamics Research Mission (GRM) are examples of enterprises that attack these problems. It is not excessive imagery to characterize these activities as constituting the new frontier."

Along with NASA's enhanced activity in the space sciences, many witnesses agreed, will come the need for greater coordination and cooperation between NASA and the National Science Foundation. The issue was addressed by the NASA Advisory Council. Dan Fink testified:

> "In the fundamental sciences, from astronomy to space physics, NASA has a shared responsibility with the National Science Foundation. Working relations generally are satisfactory, but policy interactions are limited. As a result, there is a gray area of responsibility in ground-based observations and theoretical and laboratory work associated with space missions.
>
> "NASA is sometimes reluctant to take a leadership position but strong leadership is required to make such programs a success. The Task Force recommends that, when appropriate, NASA take the lead in seeing that such programs are properly coordinated. It is imperative that space science, now a central element of scientific research in the United States, remain a principal part of NASA's mission."

In his testimony, Tom Donahue addressed Federal organization for space science, in particular the need for NASA to have a science role in addition to an engineering, or mission, role:

> "It is sometimes suggested that the support of the science investigations carried out in space . . . should be the charge of the National Science Foundation, while NASA is left with responsibility to develop and deploy the technical means to launch and support these studies. Science and engineering must interact intimately in developing the peculiar kind of missions that space science undertakes. Separating the two would be disastrous."

Administrator Beggs concurred with the need to improve NASA-NSF interaction, suggesting the situation may warrant a formal "coordinating activity".

Several witnesses addressed what they view as the major concern confronting the space science community: the low frequency of launch opportunities. According to Tom Donahue, this is a consequence of the "long delay in getting the space shuttle operational and the decision to phase out expendable launch vehicles several years ago in anticipation of the use of the space shuttle to launch space science missions."

John Naugle, former NASA Chief Scientist, gave his view of how to break the cycle whereby space science missions may be delayed for 10-15 years:

> "By increasing funding to accelerate the start of AXAF, SIRTF, SOT, UARS, and Planetary Explorers; by reducing the leadtime and cost of shuttle sortie missions and establishing permanent observatories and platforms in space to permit the same type of continuous observations and rapid response to new discoveries as the ground based astronomers have."

According to Tom Donahue, however, in the view of the Space Science Board, the space station now being considered by NASA would not necessarily help in meeting the objectives of the space science disciplines during the next 20 years.

A policy objective of the 1958 National Aeronautics and Space Act sets forth "the preservation of the role of the United States as a leader in aeronautical and space science and technology" and international cooperation in space. Tom Donahue's testimony addressed the issue of U.S. preeminence in space science:

> I cannot see that any damage would be done to our scientific and technological position if we could work out arrangements with other national and international agencies to mount space science missions in common. The resources of Europe, the USSR, and Japan and their maturity in space are sufficient to warrant more ambitious and symmetric arrangements than those we have tried in the past. [By] working together we can undertake important enterprises that none of us feels able to afford separately."

H. International Cooperation in Space

> "NASA should take action to increase awareness within the United States Government of the value of aerospace programs as instruments of foreign policy and future cooperative agreements by NASA with other nations and/or international organizations [should] be consistent with our national long-range foreign policy objectives and achieve a greater degree of stability."

This recommendation of the Mission of NASA study, reported in testimony by Dan Fink, reflects the consensus view of the witnesses on the subject of international cooperation in space. NASA's role in support of U.S. international relations, described by Fink as "sometimes misunderstood or not fully appreciated within the government" may merely reflect the inadequacy of overall policy attention to international space policy considerations.

Rep. George E. Brown, Jr., testified that greater attention to international policy considerations "could vastly enhance our leadership role in global space policy making in a way that would benefit us in many ways, as it has in the international communications field already." Brown suggested that establishment of "international institutional systems might be a way of facilitating and sharing the cost of space development."

The benefits of cost-sharing as well as the degree of scientific return from international space activity were also noted by Tom Donahue:

> "I cannot see that any damage would be done to our scientific and technological position if we could work out arrangements with other national and international agencies to mount space science missions in common. The resources of Europe, the USSR, and Japan and their maturity in space are sufficient to warrant more ambitious and symmetric arrangements than those we have tried in the past. Working together we can undertake important enterprises that none of us feels able to afford separately."

Many witnesses cited the importance of U.S. reliability and commitment in international cooperative activities in space. Along with greater international activity in space may come the need for a stronger NASA role in foreign policy. According to John Yardley,

> "NASA should lead the space aspect of the overall federal policy in these areas, much as they have done in the past. They need to have a heightened awareness of United States economic interests, as they pursue these policies."

Jerome Simonoff, of Citicorp, encouraged greater attention to financial issues involved in foreign competition, including availability of subsidized financing for exports, supplementary launch financing, cross-subsidization of products, and countertrade, or offset capability. On the latter, Mr. Simonoff recommended that NASA develop a working relationship with the Department of Commerce to develop an institutional mechanism for offset supports. Mr. Beggs concurred, but pointed out "this is a bigger question than NASA, a pervasive question that spreads across all of our trade relations in the world."

I. NASA's Next Step: The Space Station

On the eve of the President's announcement directing NASA to develop a permanently, manned space station, witnesses discussed a space station as the next logical step for NASA and the U.S. space program. According to Karl Harr,

> "The key element in advanced space operations is, of course, the permanent manned space station in low-Earth orbit. It would significantly expand our national technological base, assure our continued leadership in science and technology, and position us to meet the anticipated space challenge from abroad."

John Gibbons stressed the importance of examining national needs and opportunities which may justify a space station:

> "The space station has to be justified on the basis of a careful appraisal of what we have learned with our earlier steps in space, that a variety of national reasons -- industrialization, exploration, research, what have you -- lead us to say that it is a worthy public investment to compete with other alternative uses of public funds, public investments. The design and functions of a space station should be in terms of its mission goals, uses, and specific objectives."

Mr. Gibbons added that in view of a space station being a means to industrialization, research and exploration, "serious considerations should be given to requiring that such an effort be a joint or cooperative venture with industry, the potential industrializer, and perhaps with foreign governments, particularly with respect to research."

Rep. Walker discussed the commercial opportunities presented by a space station:

> "One of the ways in which we might be able to justify the cost of the space station would be to assure ourselves that the design included the capacity for privately launched vehicles to be served from the space station and thereby assure ourselves that private capital, as well as public capital, goes into the building of the station."

Tom Donahue also sought to clarify the Space Science Board's position on a space station:

> " . . . the space station that NASA is currently talking about is not one for which there is any strong space science requirement. Therefore, the question of whether the Nation should go forward with a space station is one that will have to be decided on grounds other than the usefulness of the space station to space science.
>
> "If the Nation decides to go ahead with the space station, then it need not be a threat to space science. What needs to be done can be understood from the problems we are having in the present space shuttle era; that is, we are having a problem with the space shuttle not because of the funding that is going into the space shuttle, but because we don't have any means to launch space science missions right now while we are waiting for the shuttle.
>
> "Therefore, if a space station is built, the means to continue to launch space science missions should be provided while the space station is being put in place, and the space station configured in such a way that if it is involved with space science missions, that it is suitably designed. Therefore, there is not necessarily any conflict between a space station program and the space science program, as we see it."

Finally, John Gibbons predicted resource constraints if a commitment to a space station is made:

> "Any major new undertaking, such as a manned space station, is either going to have to be done at the expense of much if not most of NASA's current programs, or large and sustained additional funding is going to have to be committed.
>
> "If military demands continue to stress the limits of national reources to do space work, a major new NASA effort will require not only additional funds but also some substantial start-up time, simply because the resources that are available across the nation are limited."

J. Program Balance at NASA

The Subcommittee on Space Science and Applications has long stressed as key to a healthy space program a balance among space science, applications and space transportation activities. The subject was also addressed during the October hearings. Specifically, what effect would the assignment of explicit responsibilities to operate space vehicles and promote commercialization have on NASA's R&D mission? Would these changes weaken or strengthen NASA's R&D activity?

NASA, according to Mr. Beggs, currently views the various missions as "complementary":

> "As we exploit the capabilities of the Shuttle, we have made available and have access to critical and new research opportunities. We are also furthering our knowledge of space science and applications with the tasks conducted during each mission."

The NASA role in STS operations may change in the future, Mr. Beggs noted:

> "As the Shuttle technology matures, we believe it is critical that NASA reexamine its role in Shuttle operations and utilization."

Most witnesses agreed that an expanded role for NASA in operations and commercialization could strengthen NASA's R&D activity:

Rep. George Brown, Jr., testified:

> "It would be my hope that it would strengthen the R and D mission and make the whole program more rational. I see the space program as representing a continuum from its support and encouragement and facilitating of basic research in the sciences, through the development of whole new ranges of commercially important industry."

John Naugle testified that a healthy balance among NASA's activities will depend on the availability of sufficient funding:

> "So far, NASA has maintained a reasonable balance between science, exploration, application, space and aeronautical R&D work and its operational responsibilities for transportation and tracking and data acquisition. NASA's commercial activity should be regarded as an addition to these existing vital functions; [and] additional funding and personnel should be allocated to the agency."

John Yardley suggested that NASA's R&D and commercial roles would be complementary so long as NASA avoids a regulatory role:

> "NASA could substantially expand their responsibility in the commercialization areas of research and development and facilitation of users without affecting their R&D mission. I feel that they should avoid a regulatory role which would not be compatible with their R&D activity."

But Tom Donahue expressed concern about a more enhanced role for NASA in operations and commercialization, urging that, if expanded, those responsibilities be "fenced off in such a way as not to interfere with the traditional R&D mission of NASA."

Karl Harr viewed the relationship differently, pointing out that many advancements in the space science area can be attributed to technological growth:

> "We only have had a successful space science program because of the enabling technology that was produced to allow it to exist. I think that space science pursuits are perhaps the most important thing that we can do in space in terms of payback over the long term. But they won't happen unless and until we get some of the hardware in order. Without things like the Apollo program, which was not a science program, [space science] wouldn't be anywhere."

John Gibbons identified a "gap problem between NASA's traditional activities and the commercialization or industrialization activities, that is, the gap between the research bench and the successful application of knowledge that is learned." Gibbons emphasized that we need to learn how to link the research and industrialization processes.

According to Dr. Gibbons:

> "Such a bridging requires a commitment to build institutional links and arrangements that go well beyond the present actors, that is, NASA, the academic research community and the aerospace industry."

K. Potentials for a Strong Space Applications Program

There was a clear indication among the witnesses that a stronger, more clearly defined role for NASA is essential to improve the health of the space applications program. According to Willis Shapley, who testified on behalf of the Space Applications Board,

> "The Space Applications Board would characterize the health of the Space Applications Program as uncertain and even precarious. The NASA research and development program in space applications and the related program for which NOAA is responsible are suffering because of the many unresolved uncertainties on the role of the government and the private sector. With these uncertainties on the developmental, demonstration and operational aspects it becomes very difficult for NASA to plan and defend funding proposals for the continuing long term research and development program that is needed. The current funding levels appear to us to put the nation's future technological capabilities in civilian space applications in a precarious position. It may be that our policies insufficiently recognize the link between preeminence in space and technological leadership. But general policies are unlikely to have much effect without clear decisions on the government's role and more adequate and consistent levels of budgetary support for the federal government's functions, including research and development."

Presenting the findings of the NASA Advisory Council's Mission of NASA study, Dan Fink urged that a more clearly defined role for NASA in the space applications area would not infringe on the agency's ability to respond to specific applications developments. According to the NASA Advisory Council, NASA should

> "continue to identify possible civilian applications of space operations, that early-on they involve, through a formal advisory committee structure, the appropriate users and providers of service in identifying requirements and priorities for the programs, that they conduct the research and technology development required for civilian space applications that cannot reasonably be conducted and funded by the using agencies, and that when suitable cooperative arrangements are made, they provide the utility demonstration and experimental operation of such space systems."

The recommendations of the NASA Advisory Council parallel those iterated by Willis Shapley on behalf of the Space Applications Board.

One problem that has frustrated the space applicatons area is the ability to find and develop user groups for new space technologies. According to Willis Shapley:

> "both the executive branch and the Congress should ensure that someone has a clear mandate and the resources to do it."

Shapley elaborated on the difficulties of identifying what that role and mandate should be:

> "There is a consensus, I believe, that in some areas it is a legitimate and necessary role of the federal government to sponsor tests and demonstrations by potential users. At the same time, it is generally recognized that the development of new user communities requires agressive user-oriented marketing efforts which can generally be mounted most effectively by profit-motivated private concerns. It is a challenging problem to devise a pattern of federal-private sector relationships in which government sponsored demonstration programs do not undercut the opportunities for private entrepreneurs but actually encourage them. NASA's former 'Technology Applications' program and other NASA-NOAA efforts to encourage the development of user communities provide models for consideration; whether any of the models would be applicable in the current situation is an open question at this time."

Numerous witnesses stressed the need for new programs, such as the Joint Endeavor Agreement program, designed to reduce industry risks. Mr. Harr testified:

> "The combination of high risk, large outlays and distant payoff, or the possibility of no payoff, may discourage many companies since every industrial investment must be weighed against all other opportunities that exist at the same time.
>
> "So if we expect to see broader U.S. industry participation in materials processing research, it is essential that the government give priority to programs designed to reduce industry's risk. NASA's Joint Endeavor program, which reduced the front-end money needed for space experimentation, is an important step in the right direction. There must be additional steps."

NASA's continued involvement in R&D is also essential to support applications. Harr continued:

> "NASA should lead the way into this new field of industrialization through an expanded R&D program of orbital materials processing, a comprehensive program that would reduce industry's risk by accomplishing much of the enabling research, and so provide industry with the confidence to proceed with product development."

The importance of NASA's space applications activities could also be enhanced by receiving greater visibility within NASA, according to Rep. George E. Brown, Jr. Rep. Brown recommended that NASA's "technology utilization program, the space applications program and commercialization activities be combined into a separate Office of Space Applications and Commercialization."

John Gibbons stressed the need for other management changes:

> "If NASA continues along the direction of moving from research and exploration toward one of high utilitarian value that is expressly aimed at developing information and technology that is useful beyond NASA itself, but useful in industry, then NASA has to take on and into its ranks, into its advisory committees, some of its potential customers because the process of industrialization, the movement from research to hardware, from an idea to its application, is a continuous process. The ultimate applier of that idea needs to be involved at the early beginnings, not just at the end of some stage. It does imply a new kind of presence of skills within NASA's organization itself and among its advisers that understand the process of how you do move from an idea to a marketplace."

L. Need for Fifth Orbiter

An issue of continuing, and imminent concern to the Subcommittee is the need to commit to the building of a Fifth Orbiter. The witnesses testified to the inevitability of need for a fifth shuttle orbiter.

According to Chris Kraft:

> "A four-orbiter fleet is nowhere near enough to carry out the traffic that's going to be taking place in the '90s for the demands on both the commercial uses and military uses, so it's inconceivable to me that we're going to shut down the Orbiter line and not build more. We will be very sorry for having done that.
>
> "We ought to find the best way from both an economical and a budget point of view (realizing that those two are conflicting sometimes) to keep the Orbiter line open so that the government would have the choice and the opportunity to get more Orbiters whenever they needed them."

Dr. Bob Frosch addressed the question of whether a five orbiter fleet was sufficient to meet NASA's goal of having 75 percent of the Free World launches on the Shuttle.

> "One cannot run a trucking company with just enough trucks to carry the cargo. You have to have a capability for maintenance, improvement, and for the possibility of an occasional problem."

Dr. Paine concurred:

> "I think it is very thin at four. It assumes there will not be any accidents. It assumes that the present vision we have of the Department of Defense, of the commercialization of space, and of the scientific is at the maximum."

Mr. Lujan questioned Dr. Frosch on the advisability of stretching out the space station two years to accomodate the fifth orbiter. According to Dr. Frosch:

> "What one needs to consider is whether the Congress and the President want to minimize annual expenditure or minimize total expenditure. There is always an assumption that somehow you can do magic and minimize the total cost of the project and also do it cheaply every year.
>
> "If you want to minimize the annual costs, then you have to realize when you stretch it out you are probably making the total program more expensive."

APPENDIX A - List of Witnesses

October 18, 1983

Hon. George E. Brown, Jr.
Member of Congress (D-CA)

Hon. Robert S. Walker
Member of Congress (D-PA)

Daniel J. Fink, Chairman
NASA Advisory Council

John Gibbons, Director
Office of Technology Assessment

October 19, 1983

Tom Donahue, Chairman
Space Science Board
National Academy of Science

Willis H. Shapley
Space Applications Board
National Academy of Sciences

John E. Naugle, Senior Director
Lease Craft Programs
Fairchild Space Company
(Former Chief Scientist, NASA)

October 25, 1983

John Yardley, President
McDonnell-Douglas Astronautics Co.

Dr. Christopher C. Kraft, Jr.
Former Director
NASA/Johnson Space Center

Jerome Simonoff, Vice President
Citicorp Industrial Credit, Inc.

Karl G. Harr, Jr., President
Aerospace Industries Association

October 26, 1983

Hon. James M. Beggs, Administrator
National Aeronautics and Space Administration

Panel of Former NASA Administrators:
Dr. James C. Fletcher (1970-1977)
Dr. Thomas O. Paine (1968-1970)
Dr. Robert A. Frosch (1977-1981)

APPENDIX B - Brief Sectional Analysis of the National Aeronautics and Space Act of 1958

SECTION BY SECTION ANALYSIS
NATIONAL AERONAUTICS AND SPACE ACT OF 1958 AS AMENDED

TITLE I - Policy and Purpose

(A) Space should be devoted to peaceful purposes.
(B)(1) general welfare and security of U.S. require provision be made for aeronautical and space activities.
(2) establishment of civilian aeronautical/space agency
(3) Defense - related activities remain under DOD
(C) Objectives of aeronautical/space activities:
(1) expansion of human knowledge
(2) improvement of aeronautical/space vehicles
(3) development and operation of space transportation systems;
(4) establishment of long range studies of aeronautical space activities for peaceful and scientific purposes;
(5) preservation of U.S. as leader in aeronautical and space science and technology and in their application to the conduct of peaceful activities.
(6) Information Transfer
(7) International cooperation & peaceful application of results
(8) Utilization of scientific & engineering resources of U.S.; close cooperation among agencies to avoid unnecessary duplication of effort.
(D) R&D directed toward ground propulsion systems, advanced automobile propulsion systems, and bioengineering.

Title II - Coordination of Aeronautical and Space Activities

Title II envisioned Federal-wide coordination of space activities through the National Aeronautics and Space Council and the Civilian Military Liaison Committee (both abolished). The functions of the Administrator are also delineated, include authorization to engage in international cooperative work.

TITLE III - Miscellaneous

This Title contains miscellaneous provisions including access to information, security arrangements, and property rights in inventions.

TITLE IV - Upper Atmospheric Research

This Title authorized in 1975 the establishment in NASA of an upper atmospheric research program.

ADDITIONAL VIEWS SUBMITTED BY REPRESENTATIVE ROBERT S. WALKER

As the author of the amendment to the organic NASA Act, which says that NASA ought to "seek and encourage, to the maximum extent possible, the fullest commercial use of space." I want to explain exactly what my intentions and motivations were for offering that language. In reviewing the conclusions and recommendations of the committee report, I have become concerned that the language is not being interpreted as it was intended. As a result, NASA is not being given the strategic vision it needs to see that the maximum commercial potential of space is developed. Lacking such direction, the tremendous opportunities offered by space industrialization will never be realized.

The general thrust of the recommendations implies that NASA is to establish and maintain itself as the predominant player in the rush to develop space. Specifically, I am concerned about Recommendation 5, which says that "NASA's most important contributions in providing space transportation systems are the achievement of assured, reliable access to space at a low cost," while Recommendation 7 seems to grant NASA exclusive monopoly authority to manage and direct the transition from an era of space exploration to an era of space exploitation, commercialization and eventually colonization. Taken together, these recommendations give NASA a blurred statement of purpose which can only result in a failure to reach the full potential that private sector space commercialization offers.

I would argue that NASA's most important role is to see that an environment is created which will encourage the development of space by the private sector. As a part of that strategy, NASA's role should principally be one of performing high risk innovative research and development, then turning over to the private sector as many products and by-products as possible, and as quickly as possible. Such a strategic mandate will enable NASA to concentrate on doing what it does best, while allowing the private sector to manage the tremendous load and operational aspects involved in fully developing space.

If nothing else, our recent experiences with Amtrak and the Synfuels Corporation should have taught us that government cannot be allowed to micromanage commerce, and that is particularly true about our ventures into space commercialization. All government can do is establish clear, consistent and stable ground rules and create an atmosphere in

which the development of space can become profitable. The private sector can and should handle the rest.

NASA's greatest successes came during the 1960s when, fueled by aggressive, far-sighted leadership and public enthusiasm, they were able to build up a solid research and development base from which they launched one success after another, eventually putting a man on the Moon, a goal which only fifteen years before seemed impossible--even unthinkable by many.

The 1970s were another story, though, as a near-sighted Congress whittled away at NASA's budgets. NASA, put in a position of choosing between projects which provided high-visibility short-term payoffs and those which offered a longer-term payoff, chose those which would demonstrate immediate results. Scarce resources were shifted into operational projects, such as the Skylab, and away from the innovative research and development programs which had laid the groundwork for the success of the Apollo missions. As the once solid research and development base was stretched thinner and thinner, successes became fewer and farther between, and public enthusiasm waned.

Fortunately, this Administration is rekindling that enthusiasm and public support is growing for the construction of a space station and more long-range exploratory projects. Yet given the justifiable concern over budget deficits and the need to restrain government spending, the chances of NASA ever receiving the real dollar support it enjoyed during its heyday are very slim. Therefore, in order to fully capitalize on this opportunity, alternatives must be developed.

The solution is to involve the private sector and establish incentives for them to carry as much as the operational weight as possible in developing space for commercial purposes. In the meantime, as a means of facilitating the success of the private sector's efforts, NASA should concentrate on innovative, visionary research and development. In such an environment, NASA will thrive and will once again provide the kind of research that will make the commercialization of space a grand success.

NASA should be the Lewis and Clark of the drive to settle space, blazing trails and moving back the frontiers of knowledge and science while allowing the private sector the room and flexibility to capitalize on

the opportunities that exist in space. Obviously, the transition from space exploration to space industrialization is not without its difficulties, but we should approach those difficulties as the Romans did: "Per aspera, ad astra." (Through difficulties to the stars.) The inherent strength of the capitalist system is that, by relying on risk-taking and entrepreneurial innovation, each problem can be transformed into an opportunity, and that opportunities are best exploited by the private sector, not government.

Estimates vary as to the specific size of the potential that exists iun commercializing outer space. Only 81 years ago Orville and Wilbur Wright successfully flew the first airplane for less than 15 seconds and over an area that today is covered by the wing span of a Boeing 747. Who then could have dreamed that today we would be planning to build a permanently manned space station and contemplating missions to Mars, Jupiter and beyond?

Similarly, today no one has any idea of the real potential that exists in commercializing outer space. Suffice it to say, as did Peter Glaser, that "No one today can accurately predict the global impact of the benefits of space commerce, except that we have a basic feeling that something important is happening in shaping the political and economic future of the world."

History affords relatively few opportunities to affect or even in some small way shape our future. We have that opportunity now, and by giving NASA the right kind of direction and allowing the private sector the right kind of flexibility in moving us from the Age of Space Exploration to the Age of Space Industrialization, we can capitalize on it. That is the message my amendment is intended to send.